REMARKS/ARGUMENTS

Favorable consideration of this application is respectfully requested.

This is a divisional of parent application, Serial No.10/119,414 filed 04/09/2002, claiming benefit of priority from U.S. Provisional Application Serial No.60/284,360 filed April 17, 2001; the parent application is now U.S. Patent 6,758,957 issued July 6, 2004. On 9/11/2003, an election was made in response to a restriction requirement during the prosecution of the parent application. Applicant elected to prosecute Invention I, Claims 1 – 7 drawn to a method of producing carbon nanoparticles and withdrew from prosecution Invention II, Claims 8 – 11 drawn to an apparatus. When the present divisional application, Serial No. 10/699,488 was filed October 18, 2004, Applicant canceled Claims 1 – 7 and to requested the prosecution of Claims 8-11.

In the present amendment, Applicant has amended independent claim 8 by incorporating the names of compounds used in the organic solution of the electrochemical bath and the names of the catalytic nanoparticles coating the electrodes in the electrochemical bath, the amount of the direct current voltage between the electrodes, and the results of applying the voltage in the electrochemical bath. Support for amendments to Claim 8 is found in the specification at page 2, lines 8 - 12; the paragraph bridging pages 3 and 4; page 4, lines 15-21 and Fig. 3. No new matter has been added.

The amendment to dependent claim 9 is made to remove the "means" language and state the component of the apparatus more specifically, as being "a power supply." Support for the amendment is found in the specification on page 3, lines 23-24. No new matter is added.

The amendment to dependent claims 10-11 adds a limitation that the carbon nanoparticles are produced by a catalytic facilitated electrochemical decomposition of the organic solution under

ambient conditions. Support for this amendment is found in the specification on page 3, lines 28-30. No new matter is added.

New claims 12 – 17 are presented for consideration. Support for the new claim 12, is found in the specification on page 4, lines 2-4, original claim 8, pages 3 – 5 of the specification. No new matter is added.

Favorable reconsideration is earnestly solicited in view of the following remarks directed to each enumerated paragraph in the Office Action mailed September 06, 2007.

In paragraph 1 of the Office Action of September 06, 2007, the Examiner states that the information disclosure statement filed 18 October 2004 fails to comply with 37 CFR 1.98(a)(1) and has not been considered. Applicant encloses with this Amendment a revised/substitute information disclosure statement in the proper format.

In paragraph 2 of the Office Action of September 06, 2007, under the heading **Claim Rejections – 35 USC § 103,** the Examiner states the statutory basis for all obviousness rejections in this Office action.

In paragraph 3 of the Office Action of September 06, 2007, the Examiner states the case law that gives criteria for establishing a background for determining obviousness under 35 U.S.C. 103(a).

Prior to discussing the Examiner's rejections of Claims 8 – 11 as being unpatentable over Iwasaki et al in view of other references deemed appropriate by the Examiner, Applicant has amended all of the claims herein and thereby distinguishes the present invention from the prior art by providing the details of an apparatus for producing carbon nanoparticles during an electrochemical reaction that takes place in a liquid phase under ambient conditions. [*Underlining*

added for emphasis.] Neither reference alone or in combination discloses or suggests Applicant's invention.

It was not known prior to Applicant's invention that the growth and deposition of carbon nanoparticles would occur on catalytic coated substrates serving as electrodes in an electrochemical bath of an organic solution of methanol and benzyl alcohol with the application of a direct electrical current. This inventive concept is now claimed in the amended claims 8-11 and new claim 12.

In paragraph 4 of the Office Action of September 06, 2007, the Examiner rejects claim 8 under 35 U.S.C. 103(a) as unpatentable over Iwasaki et al. (U.S. Patent 6,838,297) in view of Urayama et al (U.S. Patent 6,650,061). The Examiner argues that Iwasaki et al discloses an apparatus for producing *nanostructures* (nanotubes) comprising the components of: ...a temperature controlled electrochemical bath, electrolyte, reaction vessel... electrode, ...cathode...coating catalytic fine particles,.. nanoholes... a power supply..." and admits that Iwasaki ..."fails to explicitly disclose coating the cathode with catalytic nanoparticles."

Applicant respectfully disagrees with the Examiner's characterization of the teachings in Iwaskai et al. First, Iwasaki forms a *nanostructure* from anodized film with nanoholes cut through the anodized film on a semiconductor surface that can include carbon; that is not equivalent to the apparatus, used by Applicant, for the growth and deposition of nanoparticles during an electrochemical reaction that takes place in a liquid phase under ambient conditions. Secondly, the nanostructure by Iwasaki is obtained by anodizing aluminum. See Iwasaki et al '297 column 1, lines 12-13, and column 28, Claim 1. Such an action would certainly not produce any carbon nanoparticles. Even Iwasaki's method for producing nanoholes described in columns 7 and 8, beginning at line 24, discusses anodizing aluminum film using various types of electrolytes that

are inorganic acids. In contrast, Applicant uses an organic solution of methanol and benzyl alcohol as the liquid bath in the electrochemical reaction apparatus.

In column 19 lines 15-42, Iwasaki et al describe the formation of carbon nanotubes in "a solution consisting of 5% $CoSO_4.7H_2O$ and 2% H_3BO_3 employed as a plating bath and the electro-deposition was performed for 1 sec under application of an AC [*underlining and bold type used for emphasis*] voltage of 5 V.

Subsequently, the sample was heated at 700°C for 1 hour in a mixed gas of 2% C_2H_4 and 98% He so that carbon nanotubes were grown from the catalytic ultra-fine particles... extending outward from inside of the nanoholes..."

In summary, Iwasaki produces *nanostructures*; Applicant produces carbon nanoparticles. Iwasaki uses an *inorganic* electrolyte; Applicant uses an *organic* electrolyte solution. Iwasaki uses alternating current (AC) in the electrochemical process; Applicant uses direct current. Iwasaki uses temperatures in a range of 700° C; Applicant uses ambient conditions (10-30° C). Applicant's claims have been amended to claim these patentably distinct features.

The Examiner further argues that "Urayama et al discloses the formation of carbon nanotubes (See column 27, lines 43-56) wherein the cathode electric layer is formed from a transition metal having a catalytic action in order to provide a low formation temperature in the carbon nanotube. (See column 7, lines 25-35)"

Applicant respectfully disagrees with the Examiner's interpretation of the teachings of Urayama. First, col. 27, lines 43-56 describes an electron-source array with pores, stating that "...between the cathode electrodes formed on the surface of a substrate and the electron emitting sections inserted into the insulation film having the pores, a ballast resistance layer and a conductive layer are formed in this order from the surface of the cathode electrodes ...the

conductive layer is made of ... nickel, iron,..." Thus, the identified column and lines do not disclose the formation of nanotubes, as alleged.

Urayama et al discuss the use of carbon nanotubes as filler material in the pores of the electron-source array. See column 7, lines 25-35, column 27, lines 57-67; paragraph bridging columns 28-29. In column 7, lines 29-35 of Urayama et al, discusses the formation of the cathode electrode layer, stating that "a transition metal, ... having a catalytic action, such as iron, makes it possible to provide the following effects: a low formation temperature, a reduction in structural defects in the carbon nanotubes, and a selective growth at necessary portions." This statement follows a sentence regarding the filling of pores with carbon nanotubes and in column 8, lines 30-35, the production of carbon nanotubes is discussed as follows: "After the formation of the pores..., ethylene and hydrogen, which are materials of carbon nanotubes, are allowed to flow in the plasma CVD process so as to form carbon nanotubes in the pores; however, the growth is completed at a level in which the tip of the carbon nanotube is maintained slightly lower than the alumina surface. . ." This would certainly suggest to a person of ordinary skill in the art that Urayama et al. use the *chemical vapor deposition* (CVD) process to produce carbon nanotubes.

Thus, Iwasaki et al. in view of Urayama et al. does not make obvious the use of Applicant's apparatus having electrodes coated with catalytic nanoparticles of iron and nickel for the growth and deposition of carbon nanoparticles from an organic solution of methanol and benzyl alcohol, with the application of **DC** voltage under **ambient conditions**.

Applicant respectfully requests that the rejection of claim 8 under 35 U.S.C. 103(a) as unpatentable over Iwasaki et al et al. (U.S. Patent 6,838,297) in view of Urayama et al (U.S. Patent 6,650,061) be withdrawn.

In paragraph 5 of the Office Action of September 06, 2007, the Examiner rejects claim 9 under 35 U.S.C. 103(a) as unpatentable over Iwasaki et al et al. (U.S. Patent 6,838,297) in view of Bell (US 4,310,393). The Examiner argues that "...modified Iwasaki et al discloses all of the claimed limitations as discussed with respect to claim 8 above, further disclosing an electrochemical system with voltage, a catalyst and electrolyte... yet fails to discuss a current density of approximately 12 milliamps per square centimeter between the electrodes." Bell is cited by the Examiner as disclosing "an electrochemical process containing a catalyst, direct current (voltage supply required) and electrolyte where current densities within the range of from about 1 – 1000 milliamps per square centimeter between the anode and cathode... It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the current density in Bell in the apparatus of modified Iwasaki et al.

The Examiner overlooks the teachings in Bell that a carbon monoxide atmosphere (Fig. 1, Claim 1, Claim 4) is used in an electrochemical carbonate process where an electric current is used to precipitate carbonate salts. Applicant strenuously objects to the selection of a reference that is not in any way related to the preparation of carbon nanoparticles in an electrochemical reaction/apparatus using an organic solvent in ambient conditions. Further, as pointed out in detail above, Iwasaki et al (modified) in view of Urayama et al do not make obvious the use of an apparatus having electrodes coated with catalytic nanoparticles of iron and nickel for the growth and deposition of carbon nanoparticles from an organic solution of methanol and benzyl alcohol, with the application of **DC** voltage under **ambient conditions**. The addition of the teachings in Bell who uses a carbon monoxide atmosphere in a totally unrelated electrochemical *carbonate* process does not make Applicant's process obvious to one of ordinary skill in the art.

Even, the Examiner admits that "the combined references still fail to disclose applying the current density for a sufficient time so that the carbon nanoparticles are developed on said electrodes." However, the Examiner hastens to add that "It would have been obvious to one of ordinary skill in the art ... to supply current density for a sufficient time so that the carbon nanoparticles are developed on said electrodes..." Applicant agrees with the commonsense of that argument; however, with the amendments to the claims herein, neither Iwasaki et al in view of Urayama et al; nor Iwasaki et al in view of Bell make it obvious to use an electrochemical reaction and apparatus to prepare carbon nanoparticles from an organic liquid at ambient temperatures and pressures.

In paragraph 6 of the Office Action of September 06, 2007, Claims 10-11 are rejected under 35 U.S.C. 103(a) as unpatentable over Iwasaki et al et al. (U.S. Patent 6,838,297) in view of Smalley et al (US 2002/0159943).

The Examiner argues that "Smalley et al discloses a method for producing nanotubes ... wherein carbon nanotubes have diameters ranging from about .6 nm up to ...100 nm and length ranging from 50nm to 1 millimeter..." However, with regard to the complete teachings of Smalley et al, the Examiner has glossed over the most important details and provides a general description of single-wall nanotubes produced by Smalley et al using vapor phase growth of carbon nanotubes NOT the electrochemical decomposition of methanol or benzyl alcohol (organic solutions) using catalytic nanoparticles of iron and nickel and direct current, as described and claimed by Applicant.

Smalley et al also uses laser vaporization methods to produce single-wall carbon nanotubes. In contrast, Applicant uses direct current in an electrochemical bath with catalyst coated electrodes to produce carbon nanoparticles of a similar dimension to those of Smalley et al.

A person skilled in the art would not find Smalley et al's teachings of laser vaporization suggestive or instructive in the production of carbon nanoparticles using Applicant's apparatus.

The invention discovered by Applicant and now claimed in amended Claims 8-11 and new claim 12 is neither suggested nor discernable from the cited references individually or collectively. Applicant provides an apparatus for producing carbon nanoparticles from an electrochemical bath containing an organic solution with catalytic nanoparticles of iron and nickel coating the electrodes and a direct current power supply that promotes the growth and deposition of carbon nanoparticles on the catalyst coated electrodes.

The application and claims are believed in condition for allowance in their amended form; allowance of Claims 8-11 and new Claims 12 - 17 is respectfully requested. If the Examiner believes that an interview would be helpful, the Examiner is requested to contact the attorney at the below listed number.

Respectfully submitted,

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